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Commuting by car or public transportation? A social dilemma analysis of travel mode judgements

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Abstract

The current paper analyses judgements regarding the decision to commute by car versus public transportation in terms of a conflict between immediate self-interest and long-term collective interest (i.e. social dilemma). Extending traditional formulations of rational choice theory, the present study revealed that preferences for public transportation (i.e. the presumed cooperative option) in a standard commuting situation were enhanced not only by the belief that public transportation provided a shorter average *travel time than car (i.e. the presumed noncooperative option), but also by the belief that public transportation was at least as* reliable *(i.e. an equal or lower variability in travel time compared to car). Moreover, paralleling prior research on experimental social dilemmas, preferences were found to be affected by a pro-social concern — the belief regarding the impact of cars on the level of environmental pollution. Our findings indicated that any combination of two such considerations (i.e. travel time, variability, and impact of cars on pollution) was more effective in promoting public transportation preferences than the sum*

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of their separate effects. Finally, we obtained evidence that commuter preferences were also shaped by individual differences in social value orientations (i.e. preferences for patterns of outcomes for self and others) in that, relative to pro-self commuters, pro-social commuters exhibited greater preference for public transportation.

> Humanity is conducting a grand experiment on its natural environment and cannot afford to fail. We have only one earth on which to experiment.
>
> Stern (1992, p. 271)

INTRODUCTION

The functioning of societies is perhaps most strongly challenged by social dilemmas — situations in which private interests are at odds with collective interests (Dawes, 1980; Messick & Brewer, 1983). One of the more problematic social dilemmas that societies are facing today concerns the fact that many personally attractive and convenient behaviours, such as private car use, are detrimental to the environment shared by all members. Although many scientists have described environmental pollution as a pervasive social dilemma (e.g. Hardin, 1968; Orbell & Dawes, 1981; Samuelson, 1990; Stern, 1992), this analysis has received little empirical attention from social dilemma researchers (i.e. they have tended to focus on experimentally created social dilemmas using experimental games as decision tasks; for some exceptions, see Brechner & Linder, 1981; Samuelson, 1990). Thus, it is relevant to provide evidence in support of the claim that the extant social dilemma literature can indeed contribute to an understanding of the psychological mechanisms underlying environmental behaviour.

The current research focuses on a number of motivational factors underlying individual judgements of one particular, but significant environmental behaviour — the decision to commute by car versus public transportation. Using extensions of rational choice theory (Olson, 1965) and insights from interdependence theory (Kelley & Thibaut, 1978), we provide a conceptual framework towards understanding how differences in mean travel time, variability in travel time, and the impact of car use on the environment may affect public transportation preferences in a hypothetical commuting situation. Moreover, we analyse how individual differences in social value orientations — preferences for patterns of outcomes to self and others (Messick & McClintock, 1968) — are related to these commuting preferences.

Self-interested motives in a social dilemma: minimizing the costs of travel time and travel time variability

The decision to commute by car or public transportation not only bears an impact on the well-being of the individual commuter, but also on the well-being of others. For example, as more individuals commute by car, people may experience the negative consequences of environmental pollution and traffic congestion. This situation is potentially disruptive, because the individual interest is generally better

served by a choice for the car (i.e. the presumed non cooperative option), as it may provide better outcomes in terms of travel convenience, flexibility, and travel time. However, it is in the interest of all if more people decide to commute by public transportation (i.e. the presumed cooperative option), which would minimize the contributions to pollution and congestion. This particular type of interdependence with conflicting individual and collective interests can be framed as a social dilemma (e.g. Dawes, 1980; Messick & Brewer, 1983)[1].

According to some original theories of social dilemmas, such as game theory and rational choice theory (e.g. Luce & Raiffa, 1957; Olson, 1965), individuals wish to maximize expected subjective utility, preferring options that are expected to yield greatest individual gains or smallest individual losses. In the context of commuter decisions, one relevant attribute that defines utility for most commuters is *travel time*. Indeed, prior research has revealed consistently that commuter decisions are influenced by time considerations with individuals preferring the option that is least costly in terms of average travel time (e.g. Kropman & Katteler, 1993; Loos & Kropman, 1993).

However, we assume that individuals respond not only to differences in average travel time, but also to differences in *variability* of travel time (i.e. unexpected variations in daily travel times). This variability may result in numerous psychological and social costs, both for the individual commuter who is confronted with a great deal of uncertainty (e.g. 'when will I arrive at work?') and for the organization for which he or she works (e.g. meetings might have to be cancelled). Despite the prevalence of time variabilities in daily commuting traffic, this factor has been largely neglected in traffic research (for exceptions, see Mahmassani & Chang, 1985; Van Knippenberg & Van Knippenberg, 1986). However, the issue of uncertainty has been addressed thoroughly in psychological research on decision making, revealing that people prefer behavioural options providing certain outcomes more than options providing uncertain outcomes (for reviews, see Abelson & Levi, 1985; Dawes, 1988). Frequently, this tendency is so powerful that it leads to preferences which are largely inconsistent with the basic assumption underlying traditional formulations of rational choice theory — to maximize expected utility — because people tend to prefer certain outcomes moderate in size more than uncertain outcomes great in size (*cf.* Kahneman & Tversky, 1979)[2]. The need for certainty has been attributed to the individual's desire to exercise control over his or her own outcomes. Uncontrollable events may elicit feelings of anger, frustration and stress, and may lead individuals to search for information about how to increase personal control or opt for behavioural alternatives providing more controllable outcomes (Averill, 1973; Bandura, 1986). Similarly, great variations in daily travel times may

[1]In a recent paper (Van Vugt, Meertens, & Van Lange, 1995), we have argued that there are, in fact, two different kinds of interdependence structures underlying commuter decisions. One is based on an interpretation in terms of environmental pollution, which could be described as an *N*-person Prisoner's Dilemma. The other is based on an interpretation in terms of traffic congestion and could be described as an *N*-person Chicken Dilemma.

[2]This tendency is known as the 'certainty-effect'. As an example, Kahneman and Tversky (1979) asked subjects to choose between two options. Option A described a gain of $4000 with a 0.8 probability, and option B described a gain of $3000 for sure. It appeared that only a small minority (20 per cent) preferred the more uncertain option A, although this option represented the greatest expected utility.

reduce the sense of personal control associated with a certain type of travel mode and may stimulate the search for alternatives.

Taken together, on the basis of rational choice theory we predict, first, that commuters will exhibit a greater preference for public transportation (versus car) if this option yields a lower average travel time (*hypothesis 1*). Second, on the basis of prior research on decision making, we predict an independent effect of travel time variability, such that individuals will exhibit a greater preference for public transportation (versus car) if it provides a smaller variability in travel time (*hypothesis 2a*). Third, it is expected that the effect of variability can be explained, at least in part, by a decrease in the perceived controllability of the travel time by car (*hypothesis 2b*).

Minimizing the costs for all of us: the role of social value orientations

The above reasoning delineates two motivational processes underlying commuting preferences (i.e. reduction of time loss and reduction of time uncertainty) that follow soundly from prior theorizing and research regarding decision making. While these motivational processes may provide a parsimonious framework for understanding individual judgement and decision making in situations where the social implications are small, we believe that this approach is too limited for understanding social dilemmas. Specifically, these motives alone would suggest that individuals construe social dilemmas primarily or exclusively in terms of their own personal outcomes. However, one of the major findings of prior social dilemma research is that a substantial number of people take into account broader considerations, derived from a general concern with the well-being of the collective (*cf.* Dawes, 1980; Messick & Brewer, 1983; Van Lange, Liebrand, Messick & Wilke, 1992). Indeed, following Kelley and Thibaut's (1978) *interdependence theory*, one may assume that individuals transform any given interdependence situation—'the given matrix' or a situation delineated in terms of the pursuit of immediate self-interest—according to broader motivations and considerations that individuals bring into the situation. The result of this transformational process is what Kelley and Thibaut (1978) have termed 'the effective matrix', which is assumed to be more predictive of individuals' ultimate preferences and behaviours in settings of interdependence. Of most interest here are the so-called *pro-social* transformations, which may be inspired by more specific concerns such as the desire to promote collective welfare, to provide a good example for others, or to enhance a good feeling about oneself (e.g. to act responsibly and in line with one's moral values or principles).

An important question then is what determines the willingness of individuals to forego the immediate self-interest, and to pursue the collective welfare? First, transformational processes may be largely shaped by pre-existing individual differences in *social value orientations*, or the ways in which individuals evaluate outcomes for self and others. This construct has received considerable attention in research on social dilemmas, revealing that those who tend to maximize outcomes for self and others (i.e. pro-socials) choose more cooperatively and expect others to choose more cooperatively than those who tend to maximize own outcomes with little or no regard for others' outcomes (i.e. individualists), or those who tend to maximize own outcomes relative to the outcomes afforded to others

(i.e. competitors, e.g. Kuhlman & Marshello, 1975; McClintock & Liebrand, 1988; Van Lange & Kuhlman, 1994). Moreover, there is also some evidence for the ecological validity of social value orientations in that pro-socials exhibit greater willingness to participate voluntarily in psychology experiments, and that they make greater concessions in the context of a negotiation task than do individualists and competitors (De Dreu & Van Lange, in press; McClintock & Allison, 1989).

Nevertheless, in light of the ubiquity of interdependent situations in the real world, this evidence is rather limited, and the concept of social value orientation has received virtually no attention in the context of environmentally relevant attitudes and behaviour (except Van Vugt, Meertens & Van Lange, 1995). This latter issue seems particularly important given Stern's (1992) comprehensive analysis of the psychological determinants of environmental damage, in which he concluded that prior research hardly revealed any systematic relations between personality factors and environmentally relevant judgements and behaviours, and that little is known regarding the personal motives and values—such as egoism and altruism—underlying environmentally relevant behaviour (for an exception, see Stern, Dietz & Kalof, 1993). Therefore, we explore whether, relative to individualists and competitors, pro-socials are more likely to take into account the long-term, collective consequences of their decisions in the commuting situation, assigning greater weight to how much harm cars and public trnasportation would do to the environment, and less likely to consider exclusively their own immediate outcomes (e.g. travel time, travel convenience or travel flexibility). Accordingly, we predict that pro-socials will exhibit a greater preference for commuting by public transportation than individualists and competitors (*hypothesis 3*).

Second, we propose that pro-social transformations are also instigated by the extent to which available options differ in their consequences to the collective welfare—how much the travel options differ in their damaging effects on the environment. When cars have only a minor impact on the environment, collective concerns will not be very salient, and commuters presumably will not be strongly motivated to give up their individual interest (i.e. commute by car). However, when the environmental impact of car use is large, individuals may more strongly realize the detrimental effects of car use, yielding a stronger concern with the long-term collective welfare (*cf.* Jorgenson & Papciak, 1981; Samuelson, Messick, Rutte & Wilke, 1984). Thus, we predict that, across variations of the consequences for self, individuals will exhibit a greater preference for public transportation when they believe that car use has a large rather than a small impact on environmental pollution (*hypothesis 4*).

Interaction of self-interested and pro-social motives

The above framework considers the separate effects of two self-interested concerns (i.e. reduction of travel time and variability), a pro-social concern (i.e. impact of car use on environmental pollution), and a factor associated with the personal evaluation of self-interested and pro-social concerns (i.e. social value orientation). Rather than merely predicting independent effects, we propose that some of these factors may interact to determine commuter judgements and preferences. As noted by some social dilemma researchers, it frequently may be that the combination of

two factors yield greater effects than one would expect on the basis of their separate effects (e.g. Liebrand, 1992; Samuelson, 1990; Stern, 1992). This may be so because often it is necessary to simultaneously overcome a number of barriers, any one of which may prevent the emergence of pro-social behaviour. In the context of commuting decisions, this assertion seems to be particularly valid because the individual advantages of car use are myriad (e.g. travel convenience, flexibility, travel time, protection against weather), and have to be weighted against a very limited number of individual advantages (e.g. time to read), and a single long-term collective advantage (i.e. environment) associated with public transportation use. Accordingly, it seems reasonable to expect that preferences for public transportation may be strongly enhanced if *two* important obstacles will be removed at the same time. Therefore, we predict that commuters will exhibit a much stronger preference for public transportation (versus car), if this option provides both (1) a lower average travel time, and (2) an equal travel time variability (*hypothesis 5*).

In addition, the effects of factors relevant to understanding individuals' concern with short-term self-interest (i.e. travel time) and long-term collective interest (i.e. impact of cars on environmental pollution) may be influenced by differences in social value orientations. Given the fact that pro-social individuals are more concerned with the collective consequences, and individualists and competitors with the personal consequences of their decisions, we advance two additional hypotheses. First, consistent with previous research (Kramer, McClintock & Messick, 1986) we suggest that when the collective interest is not or not seriously affected by individuals' decisions then pro-socials, individualists, and competitors will exhibit similar levels of cooperation; however, when the collective is being threatened pro-social individuals will be more likely to exercise self-restraint, whereas individualists and competitors are more likely to improve their outcomes when they are still able to do so. Thus, we predict that—relative to individualists and competitors—pro-social commuters will be more sensitive to information that cars contribute heavily to environmental pollution. Accordingly, pro-social commuters will exhibit a stronger increase in public transportation preference between the situations where cars have a small versus large impact on environmental pollution than individualists and competitors (*hypothesis 6*).

Conversely, individualists and competitors might be more responsive to information about how their commuting decision will affect their self-interest, which will presumably depend on the relative efficiency of public transportation. Accordingly, we predict that individualists and competitors—relative to pro-socials—will exhibit a sharper increase in public transportation preference from the situation where public transportation yields a longer travel time (versus car) to where public transportation yields a shorter travel time (*hypothesis 7*).

Experimental paradigm

The current research employs a relatively novel methodology for studying transportation preferences—a paradigm that substantially differs from the well-established experimentally created social dilemmas. This paradigm utilizes descriptions of commuting situations so as to model real-life commuter decisions as closely as possible. Ideally, one would like to examine these decisions in the real world.

However, it is exceedingly difficult to successfully manipulate differences in average travel time, travel time variability, and impact of cars on environmental pollution in real-life, because there are various situational and ethical constraints to do so (for related reasoning, see Weiner, 1980). Nevertheless, to enhance the external validity of the study we recruited a sample of real car commuters who responded to different scenarios in which these variables were systematically varied. Moreover, the outcomes associated with these options were represented in terms of travel time (individual outcome) and environmental damage (collective outcome).

While these two outcomes are assumed to be important, we do not claim that these are the only attributes or evaluations that commuters take into account. Accordingly, we administered a post-experimental judgement task in which we asked subjects to evaluate the importance of a list of travel attributes (e.g. protection against bad weather) in their real-life commuting decisions. This allows us, first, to examine whether individuals indeed construe the commuting situation as a social dilemma. If so, attributes reflecting individual outcomes (e.g. travel time, travel flexibility, travel convenience) should correlate negatively with public transportation preferences, whereas the opposite should occur for attributes reflecting collective outcomes (i.e. environment). Second, this allows us to examine the assumed relationship between these evaluations and social value orientation: relative to individualists and competitors, pro-socials should assign greater importance to collective outcomes and less importance to individual outcomes.

METHOD

Subjects

Three hundred questionnaires, were distributed among employees of a publishing company in Deventer—a medium-sized city in the middle of the Netherlands. In total, 192 questionnaires were returned (104 by men, 88 by women), yielding an overall response rate of 64 per cent. The average age of the subjects was 35 years and eight months. All subjects were regular car commuters, and more than half of them (51 per cent) commuted by car on a daily basis. The rest occasionally (i.e. less than once a week) commuted by bike (38 per cent), or by public transportation (11 per cent).

Overview of the design

By means of different future scenarios of a commuting situation, the following independent variables were manipulated. First, the *relative travel time* of public transportation versus car was varied: in one condition the travel time by public transportation was shorter than by car, whereas in the other condition the travel time by public transportation was longer. The second factor was *relative travel time variability*, and consisted of three conditions in which public transportation—relative to car—either had a smaller time variability, an equal time variability, or a greater time variability. The third factor involved the differential magnitude of the

environmental damage produced by cars. It was stated that car use either had a large or small impact on environmental pollution. Finally, we examined social value orientations, which focused on differences between the group of pro-socials versus the group of individualists and competitors combined ('pro-selfs')—the reason for this two-category distinction will be described below. Thus, the experimental design was a 2 (time) by 3 (variability) by 2 (social value orientation) by 2 (pollution) design. All variables except one were between-subjects factors and cell sizes varied from nine to 55 commuters (due to a substantial unevenness in the number of pro-social versus pro-self people). For reasons of statistical power, the factor variability was manipulated within subjects and the three variability conditions were presented to commuters in random order to control for possible order effects.

Procedure

The questionnaires were distributed to car commuters at the entrance of the company on a weekday morning, and completed at the working place in about 20 minutes (those who returned their questionnaires were thanked, and were given a small gift for their participation). The questionnaire consisted of three parts: (1) the assessment of an individual's social value orientation, (2) the description of a commuting situation, and (3) a series of post-experimental questions.

The assessment of social value orientation

As a first task, nine decomposed games (*cf.* Messick & McClintock, 1968) were administered. In each decomposed game a choice is made between combinations of outcomes—depicted in amounts of money or points—to self and an hypothetical other person, a measure of social value orientation which has revealed good internal validity (e.g. Liebrand & Van Run, 1985), as well as test–retest reliability (e.g., Eisenberger, Kuhlman & Cotterell, 1992; Kuhlman, Camac & Cunha, 1986), and appears to be free of tendencies towards social desirability (Platow, 1992). Paralleling prior work, each game consists of three alternatives, corresponding to one of three social value orientations: cooperation, individualism, or competition. Specifically, in a decomposed game the cooperative option provides the greatest joint outcome, the individualistic option the greatest outcome for self regardless of other's outcome, and the competitive option the greatest difference between outcomes for self and other. In line with previous research (McClintock & Allison, 1989; Platow, McClintock & Liebrand, 1990), subjects were only classified if at least six of the nine choices were consistent with one social value orientation. Accordingly, out of 192 individuals, 141 were classified as pro-socials, 31 as individualists, and 10 as competitors. Ten people could not be categorized on the basis of the above criterion. Due to the low number of individualists and competitors, and given the fact that there were no different predictions for these groups, we combined individualists and competitors to form a group of essentially self-interested individuals, a group which we have earlier referred to as 'pro-selfs' (*cf.* Kramer *et al.*, 1986; Van Lange & Liebrand, 1991).

Description of the commuting situation

Next, commuters were asked to read the description of an hypothetical commuting situation, which was designed in an attempt to parallel a commuting situation that presumably can be found within a 10-year period from now (an example is provided in the Appendix). The aim of such future scenarios was to optimize the credibility of the different manipulations that may seem somewhat unrealistic at present. Commuters were asked to imagine that they were living in a suburb 40 kilometres from the company they worked for (approximately 25 miles). They could cover this distance to work either by car or by train. There was a highway near home, and a train station at a three-minute walk. Once the commuting situation was explained, individuals were told that their choices would have consequences for the amount of environmental pollution produced, and for their travel time to work.

Pollution

All participants were first informed that the environment would be in a very bad condition in 10 years. Subsequently, approximately half of the people read that within a 10-year period, cars would be responsible for very little of the environmental damage, mainly because of the use of catalytic converters for cars and other environment-preserving measures (small impact-condition). In contrast, the other half of the people received information indicating that cars would be one of the main polluters of the environment within 10 years, despite several environment-preserving measures (large impact-condition). In both conditions, it was stated explicitly that public transportation would *hardly* cause any environmental damage.

Time

Half of the commuters read a scenario indicating that the average travel time by public transportation was always shorter than by car (travel time public transportation shorter-condition; from now on referred to as PTT shorter). It would take 40 minutes on average to cover the distance to work by public transportation, and 60 minutes to cover it by car. Conversely, the other people read a scenario describing that the average travel time by public transportation was always longer than by car, and the travel times were exactly the opposite (PTT longer-condition). In all conditions, it was emphasized that the travel time by public transportation included a few-minute walk from home to the station, and from the end station to their company.

Variability

Each participant received three different scenarios describing the day-to-day variability in travel time by public transportation compared to car. One scenario indicated that the time variability by public transportation was much smaller (with a range from 2 minutes below to 2 minutes above the average time) than by car (16 minutes below and above average time), creating the PTV smaller-condition. The other two scenarios informed individuals that the time variability by public

transportation was either equal to car (9 minutes below or above average; PTV equal-condition) or much greater than car (16 minutes versus 2 minutes below or above average; PTV greater-condition). These three scenarios were administered to individuals in random order. Each scnario ended with a brief summary of the consequences of commuters' decisions in terms of environmental pollution, travel time, and time variability (see Appendix).

Dependent measures

In each of the three commuting versions individuals could indicate their preferences for commuting by car or by public transportation on a bipolar response scale, ranging from 1 (=very strong preference for car) to 7 (=very strong preference for public transportation), whereby the midpoint 4 was anchored as 'indifferent'. Also, after each preference they had to make a choice between the two alternatives (1=car; 2=public transportation). Finally, in each version commuters were asked to indicate for car and public transportation separately, how much control they thought they could exercise over their travel time (1=very little control; 7=very much control).

Post-experimental questionnaires

Three different types of post-experimental questionnaires were administered. First, commuters judged the perceived control of travel times for car and public transportation in their *personal* commuting situation (1=very little control; 7=very much control). Second, they rated their concern (1=very unimportant, 7=very important) with a list of five travel attributes, which have shown to be important considerations for 'real-life' commuting decisions (e.g. Flannelly & McLeod, 1989; Golob, Horowitz & Wachs, 1979): travel convenience, travel time, travel flexibility, protection against weather, and environmental pollution. Third, as to determine how plausible the information in the future scenarios was, individuals rated two statements concerning the credibility of, respectively, the environmental and travel time conditions (1=not at all plausible; 7=very plausible)[3].

RESULTS

Preferences for car versus public transporation

Preferences for commuting by car or by public transportation were analysed in a repeated measurements ANOVA, employing a 2 (time) by 3 (variability) by 2 (social value orientation) by 2 (pollution) design, all independent variables being between

[3]Analyses revealed no difference in the credibility of travel time information between the PTT shorter ($M=4.19$) and PTT longer-conditions ($M=4.46$), $F(1,181)=1.96$, n.s. However, commuters in the large impact-condition thought that the environmental information was more plausible ($M=4.94$) than commuters in the small impact-condition ($M=3.90$), $F(1,181)=18.34$, $p<0.001$. Thus, individuals were somewhat more inclined to believe that cars would have a major impact on the level of pollution in the near future.

subjects factors, except for variability[4]. Consistent with hypothesis 1, this analysis revealed a main effect for time, $F(1,174) = 14.74$, $p < 0.001$, indicating that preferences for public transportation were greater when public transportation was associated with shorter ($M = 5.32$) than longer travel times ($M = 3.98$).

More importantly, and consistent with hypothesis 2a, we found a strong main effect for variability, $F(2,348) = 52.63$, $p < 0.001$. Public transportation was preferred most when PTV was smaller ($M = 5.41$), and least when PTV was greater ($M = 3.85$), with intermediate preferences when PTV was equal ($M = 4.87$). All paired comparisons between the conditions yielded significant differences, $p < 0.05$.

Moreover, a significant main effect for social value orientation, $F(1,174) = 4.63$, $p < 0.04$, provided support for hypothesis 3, revealing that pro-socials exhibited stronger preferences for commuting by public transportation ($M = 4.91$) than pro-selfs ($M = 4.02$).

Finally, according to hypothesis 4, commuters would display a stronger preference for public transportation when the collective costs of cars would be greater. A main effect for pollution, $F(1,174) = 29.96$, $p < 0.001$, indeed revealed that preferences for public transportation were greater when cars had a large impact ($M = 5.38$) rather than a small impact ($M = 3.88$) on environmental pollution. Thus, hypotheses 1 through 4 received good support by the four significant main effects described above.

On the basis of hypothesis 5, it was predicted that individuals would be much more in favour of public transportation if two conditions were fulfilled, namely public transportation was (a) more efficient in terms of travel time than car, and (b) more or equally reliable in terms of time variability. Evidence in support of hypothesis 5 would be obtained by an interaction time and variability, which was found to be marginally significant, $F(2,348) = 2.60$, $p < 0.08$. This effect was qualified by a significant three-way interaction of time, variability, and pollution, $F(2,348) = 6.24$, $p < 0.005$ (the associated means are displayed in Figure 1).

To provide a more precise test of the predicted interaction between time and variability, we performed for each level of the factor pollution a 2 (time) by 3 (variability) repeated measurements ANOVA. First, when cars had a *small* impact on environmental pollution, this analysis revealed a significant interaction of time and variability, $F(2,158) = 7.86$, $p < 0.001$. Consistent with hypothesis 5, the difference between a shorter (line depicted with triangle symbols in Figure 1) and longer travel time (line depicted with circle symbols) was substantially greater when PTV was smaller (M's = 5.63 versus 4.02), $t(79) = -3.78$, $p < 0.001$, or equal (M's = 4.71 versus 3.52), $t(79) = -2.84$, $p < 0.001$, than when PTV was greater

[4]Preliminary analyses revealed no significant main or interaction effects for the order in which the three variability-conditions were presented; therefore, this factor was dropped from further analysis. Additionally, we compared the main analysis using variability as within-subject factor with an analysis on the first stated commuting preference using variability as between-subjects factor. This analysis yielded the same main and interaction effects.

Finally, the continuous variable measuring commuting preference was correlated with the number of public transportation choices across the variability conditions; an extremely high intercorrelation was found, $r = 0.89$, $p < 0.001$. Moreover, we conducted a 2(time) by 2(pollution) by 2(social value orientation) ANOVA on the number of public transportation choices and the same effects were found as in the analysis on the mean commuting preference (however, the social value orientation × pollution interaction changed to marginal significance); therefore (and in order to save space), only the results on the commuting preference will be reported.

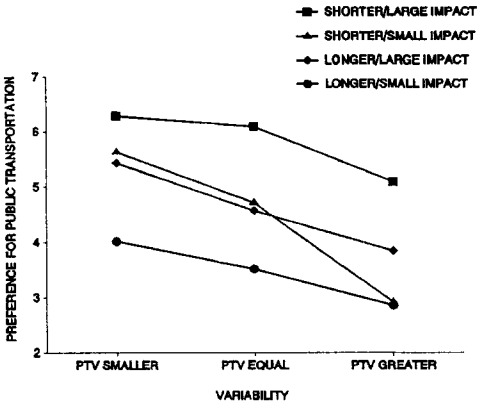

Figure 1. Preference for public transportation as a function of average time, variability, and pollution. Preference varies from 1 (=very strong preference for car) to 7 (=very strong preference for public transportation), whereby 4 (=indifferent)

(*M*'s=2.91 versus 2.85), $t(79)<1$. Second, the interaction of time and variability failed to be significant when cars had a *large* impact, $F(2,198)=1.82$, $p<0.20$.

Thus, these analyses provide partial support for hypothesis 5. That is to say, when cars had a small impact on environmental pollution, subjects indeed displayed a much stronger preference for commuting by public transportation when public transportation afforded (1) a shorter average travel time, and (2) at least an equally reliable travel time. However, when cars had a strong impact on environmental pollution there was no surplus effect of the combination of these conditions.

A *post-hoc* explanation for this finding may be that *any* combination of conditions in which two obstacles for taking public transportation were removed, *including* the situation where cars are extremely (versus mildly) polluting relative to public transportation, enhanced public transportation preferences. To examine this possibility, we combined the (weighted) mean public transportation preference of each condition where two barriers to use public transportation were simultaneously eliminated, and compared them with the means of the other conditions (see Figure 2). Consistent with this *post-hoc* reasoning, we observed a more pronounced increase in public transportation preference moving from the elimination of just one obstacle ($M=3.60$) to two obstacles ($M=5.12$; difference of 1.52 scaling points) than from the situation in which no obstacle had been removed ($M=2.85$) to one obstacle ($M=3.60$; difference of 0.75), or from two ($M=5.12$) to the situation in which all three obstacles had been removed ($M=6.19$; difference of 1.07).

Furthermore, a closer examination of the *absolute* commuter preferences in Figure 1 indicated that there were seven conditions (out of 12 in sum) in which public transportation was significantly preferred above the car. These conditions had in common that *at least* two out of three barriers to use public transportation were eliminated: it had at least an equally reliable travel time, and was much shorter and less environmentally polluting than the car. In every other condition—where no or just one obstacle to use public transportation was removed—commuters preferred commuting by car or were indifferent. These results were independent of social value

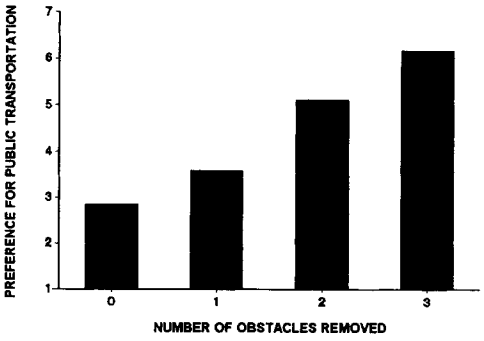

Figure 2. Preference for public transportation as a function of the number of obstacles removed for commuting by public transportation. Preference varies from 1 (=very strong preference for car) to 7 (=very strong preference for public transportation)

orientation, as was illustrated by the absence of a significant four-way interaction, $F(2,348) < 1$.

Hypothesis 6 predicted an interaction between social value orientation and pollution, such that differences between the pollution-conditions would be more pronounced for pro-socials than pro-selfs. This interaction effect was found to be significant, $F(1,174) = 4.74$, $p < 0.03$, but in a manner inconsistent with hypothesis 6. As can be seen in Figure 3, pro-selfs showed a much sharper increase between the condition when cars had a small ($M = 3.07$) versus large impact ($M = 5.22$; difference of 2.15 scaling points), $F(1,39) = 23.74$, $p < 0.01$, than pro-socials (M's = 4.20 versus 5.41; difference of 1.21 scaling points), $F(1,139) = 17.75$, $p < 0.01$. Thus, contrary to our prediction in hypothesis 6, not pro-social but pro-self commuters appeared to be more sensitive to information that the collective welfare was being threatened.

Finally, hypothesis 7 tested the prediction that preferences of pro-selfs (relative to pro-socials) would be more strongly affected by differences in travel time. However, the interaction of social value orientation and time was not significant, $F(1,174) < 1$. Thus, no evidence was found that pro-self commuters were more responsive to information about the efficiency of public transportation.

Perceived controllability of travel time

In Hypothesis 2b it was predicted that the impact of variability on public transportation preferences could, at least in part, be attributed to a loss of perceived controllability of travel time by car. To examine this, we transformed the perceived controllability of car versus public transportation travel times into a difference score, so as to parallel the relative measure of public transportation preference. For each version, a subject's controllability score of travel time by public transportation was subtracted from the controllability score of travel time by car, so that a positive score (score above 0) indicated a higher perceived controllability of the travel time by car and a negative score (score below 0) indicated a higher perceived controllability of the travel time by public transportation. Our analysis proceeded in several steps. First, we determined the average score of the three controllability ratings and found

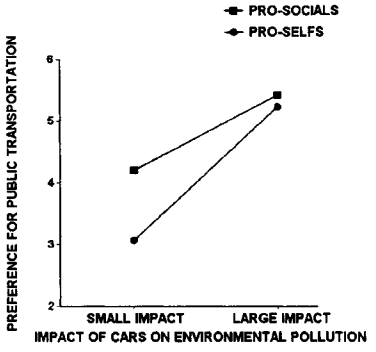

Figure 3. Preference for public transportation as a function of social value orientation and pollution. Preference varies from 1 (=very strong preference for car) to 7(=very strong preference for public transportation)

that across all conditions the perceived controllability of travel time by car was higher than by public transportation ($M = +0.58$), $t(181) = 4.40$, $p < 0.001$.

Second, the relative controllability scores were analysed in a 2 (time) by 3 (variability) by 2 (social value orientation) by 2 (pollution) design, all independent variables being between-subjects factors, except for variability. This analysis revealed a strong main effect for variability, $F(2,348) = 42.32$, $p < 0.001$. If the effect of variability on commuter preferences could, at least in part, be attributed to differences in perceived controllability of travel time, then the relative controllability score of car travel time would be higher (lower) when the time variability by public transportation would be greater (smaller). Indeed, the relative perceived controllability of driving time by car was highest in the PTV greater-condition ($M = +1.59$), and lowest in the PTV smaller-condition ($M = -0.37$), whereas the mean score fell in between ($M = +0.53$) in the PTV equal-condition.

Third, we analysed commuter preferences in a repeated measurements ANCOVA containing all factors, and included the relative controllability judgements of car versus public transportation travel times as a covariate. These preferences were strongly influenced by the perceived controllability of travel times, $F(1,173) = 35.38$, $p < 0.001$. The regression weight of -0.36 indicates that a higher perceived controllability of the travel time by car was associated with a weaker preference for commuting by public transportation. Importantly, compared to the initial analysis on commuter preferences the main effect of variability was clearly less prominent in the present analysis, which is consistent with hypothesis 2b. Although the main effect remained significant, $F(2,347) = 31.72$, $p < 0.001$, the F-value decreased considerably after controlling for the covariate (without and with covariate: F's = 52.63 versus 31.72; a decline of approximately 40 per cent). The adjusted means for this main effect indeed demonstrated less clear-cut differences between the variability conditions than the corresponding unadjusted means (presented within parentheses): variability smaller: $M = 5.07$ (5.41) versus equal: $M = 4.85$ (4.87) versus greater: $M = 4.21$ (3.85). The other main and interaction effects were relatively unaffected by the covariance analysis. Thus, the influence of greater time variability by car (versus public transportation) on the public

transportation preference is partly (but not entirely) attributable to the loss of perceived controllability of travel time commuting by car.

Finally, after the commuting task, subjects were asked to rate—both for car and public transportation—the following question: 'How much control do you think you can exercise over the travel time [by car/public transportation] in your daily commuting situation?' (1 = very little control, 7 = very much control). Again, we transformed both scores into a relative score, and compared the judgement of people who commuted by car on a daily basis ($N = 162$) with that of a group of commuters ($N = 20$) who occasionally (i.e. less than once a week) commuted by public transportation. Consistent with the previous analyses, it was found that commuters who sometimes used public transportation had a considerably lower perception of controllability of car travel time ($M = +0.74$) than daily car commuters ($M = 1.89$), $F(1,109) = 4.80$, $p < 0.04$.

Ratings of travel attributes of car versus public transportation

One of the assumptions of the present study was that the commuting context would, at least to some extent, reflect a conflict between individual (i.e. commuting by car) and collective interests (i.e. commuting by public transportation). Moreover, we argued that the deliberation between these interests may, in part, be determined by an individual's social value orientation. Thus, at the end of the experiment commuters were asked to rate the importance of a list of travel attributes in their daily-life commuting decisions (1 = very unimportant, 7 = very important). These travel attributes varied to the extent that they served either the individual (i.e. travel flexibility, travel convenience, protection against weather, and travel time) or the collective interest (i.e. environmental pollution).

If the commuting situation under investigation indeed reflected the structure of a social dilemma then the self-interested attributes would be negatively and the collective attribute would be positively correlated with public transportation preferences. Accordingly, we performed a correlational analysis between these travel concerns and the preference for commuting by public transportation (the average score over three commuting versions). As expected, the concern for environmental pollution had a high, positive correlation with the preference for commuting by public transportation ($r = 0.53$, $p < 0.01$), whereas travel flexibility ($r = -0.52$, $p < 0.01$) and protection against the weather were negatively correlated with public transportation preference ($r = -0.25$, $p < 0.01$)[5]. Moreover, all individual concerns (travel flexibility, travel convenience, travel time, and protection against the weather had high intercorrelations. These findings were corroborated by a series of regression analyses, revealing that both the collective benefit—environment—and one of the individual benefits—travel flexibility—made independent, significant contributions toward predicting overall preferences for public transportation (the average preferences across the different levels of variability).

[5]A comparison between the ratings given by daily car versus occasional public transportation commuters revealed no systematic differences.

Second, we hypothesized that pro-socials would attach more importance to the long-term collective outcomes of their decisions, whereas pro-selfs would attach more importance to the short-term self-interested outcomes. In a MANOVA we compared the ratings of pro-social and pro-self individuals on the two most influential travel attributes, environmental pollution and travel flexibility. This analysis revealed a significant multivariate effect, indicating an overall difference in ratings between pro-social and pro-self individuals, $F(2,179) = 3.32$, $p < 0.04$. The associated means per attribute demonstrate that pro-socials assigned greater value to environmental pollution ($M = 5.74$) than pro-selfs ($M = 5.22$), $F(1,180) = 5.68$, $p < 0.02$. Conversely, pro-selfs tended to assign greater value to travel flexibility ($M = 5.61$) than pro-socials ($M = 5.22$), but this effect failed to reach acceptable levels of significance, $F(1,180) = 1.68$, $p < 0.20$. Taken together, these results provide partial support for the claim that pro-social commuters are more concerned with the long-term collective outcomes of their commuting decisions and pro-self commuters are more concerned with their short-term outcomes.

DISCUSSION

The major purpose of this work was to examine the motivational factors underlying individuals' judgements of the decision to commute by car or public transportation. A social dilemma analysis was advanced so as to demonstrate that preferences for public transportation might be promoted by both self-interested and pro-social motives. The current findings provided strong evidence in support of hypotheses 1 and 2a, in that individuals preferred options yielding shorter travel times as well as smaller variabilities in travel time. Moreover, preferences for public transportation were also affected by broader, pro-social considerations. In line with hypothesis 3, pro-social individuals exhibited greater preferences for commuting by public transportation than did pro-self individuals. In addition, consistent with hypothesis 4, preferences for public transportation were greater when individuals were confident that excessive car use was detrimental to the environment. Moreover, we observed that the elimination of two obstacles to use public transportation promoted preferences for public transportation more strongly than the sum of their separate influences, which is in partial agreement with hypothesis 5. Finally, contrary to hypothesis 6 pro-self individuals were more sensitive than pro-social individuals to information about the detrimental effects of car use on the environment. Also, contrary to hypothesis 7 both groups were about equally responsive to information about the efficiency of public transportation. Below, we will briefly discuss these and some other findings, evaluating their theoretical and practical implications.

First, the current findings revealed strong evidence that commuter preferences are shaped not only by beliefs regarding differences in average travel time, but also by knowledge concerning the differences in variability of travel time. Assuming that time is an important resource or outcome, these findings in combination extend original claims underlying rational choice theory (Olson, 1965) by indicating that individuals assign meaning not only to outcomes *per se*, but also to the variability in these outcomes. Consistent with prior laboratory research, this latter result illustrates that individuals prefer options yielding certain outcomes above ones yielding uncertain

outcomes (i.e. uncertainty caused by variability in travel times), independent of other features of these outcomes (e.g. average travel time). From a more empirical perspective, this finding extends prior research on decision making, which to our knowledge has confirmed this 'certainty'-effect (Kahneman & Tversky, 1979) primarily in individual decision tasks. Thus, the current finding underlines the need for minimizing the costs of uncertainty as a major psychological motive at work in social dilemmas, situations in which people frequently have to make decisions under a great deal of uncertainty regarding the state of the collective resource and strategies of other people ('environmental and social uncertainty'; *cf.* Suleiman & Rapoport, 1989).

Beyond this (and in support of hypothesis 2b), the current results revealed that differences in perceived controllability partially accounted for the effect of variability in travel time on commuter preferences. Once the influence of perceived controllability was statistically controlled for, variability in travel time accounted for a considerably smaller (although still quite substantial) amount of variance in preferences for public transportation. Also, we found that a greater perceived controllability was associated with a lower preference for commuting by public transportation, indicating that an individual's desire to exercise control over his or her outcomes is an important psychological drive underlying commuter preferences. Accordingly, while perceived variability in travel time seems quite unpleasant, it is even more aversive when individuals think they cannot somehow influence or control this variability. This may help to understand why many individuals fail to commute by public transportation, because these modes of transportation are associated with some variability in travel time which they cannot control themselves. In contrast, commuting by car may also be associated with variability in travel time (i.e. caused by traffic congestion), but people may think that they are better able to control this type of unpredictability (e.g. by listening to radio announcements about traffic jams, by taking 'short-cuts'). However, in light of increasing traffic jams, it may be possible to encourage the use of public transportation if commuters could be convinced that public transportation is relatively more reliable than their cars. This implication nicely complements prior research revealing that traffic congestion is associated with a perceived lack of control among car drivers, which in turn causes high levels of stress (Schaeffer, Street, Singer & and Baum, 1988; Stokols, Novaco, Stokols & Campbell, 1978).

A second finding was that commuter preferences were influenced by individuals' social value orientations, with pro-socials exhibiting greater overall preferences for public transportation than pro-selfs (i.e. individualists and competitors). This finding extends prior work which simulated environmentally relevant decision problems in laboratory settings (Kramer *et al.*, 1986; Van Vugt *et al.*, 1995). Along with this prior research, the current findings provide some support for the claim that social value orientations influence behaviour in real-life social dilemmas — a claim often made by researchers interested in this individual differences-variable, but rarely ever tested directly. More generally, these findings are important because they provide evidence in support of: (a) the assertion that individuals' preferences in a real world social dilemma are also governed by pro-social motivations (i.e. not all people focus on the 'given matrix' representing outcomes for self only; Kelley & Thibaut, 1978), (b) the ecological validity of the concept of social value orientation (i.e. most prior research has examined social value orientations in the context of experimental games), and (c) the claim that environmentally relevant judgements and behaviours are shaped by

personality variables (i.e. the extant literature suggests that such relationships tend to be weak or absent; *cf.* Stern, 1992).

However, in the current study no evidence was obtained for the predictions that pro-social commuters, relative to pro-self commuters, would be more sensitive to information about the collective outcomes (i.e. environmental pollution) and less sensitive to information about the personal outcomes (i.e. travel time) of their commuting decisions. First, that pro-socials and pro-selfs showed a similar increase in preference for public transportation when this option became more efficient in travel time is understandable from a theoretical model of social value orientations, which suggests that all individuals assign an equal, positive value to outcomes for self, but that pro-socials and pro-selfs differ in the values they assign to outcomes for others — with pro-socials assigning positive values to outcomes for others, and pro-selfs being either indifferent (i.e. individualists) or even assigning negative values (i.e. competitors) to outcomes for others (*cf.* McClintock & Liebrand, 1988; Wyer, 1969). From this perspective, it is understandable that pro-socials and pro-selfs were equally responsive to information concerning their self-interest (i.e. travel time). Consistent with this explanation is the finding in the post-experimental judgement task that pro-socials attached more importance to the environment than did pro-selfs, but that both groups did not significantly differ in the importance they attached to self-interested concerns (i.e. travel flexibility).

Second, and also contrary to our prediction was the finding that pro-self (rather than pro-social) commuters were more strongly affected by information about the detrimental effects of car use, so that their public transportation preferences paralleled those of pro-social commuters when car use had a great impact on the environment. How do we account for this finding? One *post-hoc* interpretation is that pro-self individuals shift from the pursuit of immediate self-interest toward one of greater collective interest when the social dilemma is critical, and the consequences of their choices in terms of pollution are severe. Pro-selfs may do so because they start to believe that, given the necessity of such pro-social choices (a) most others would do the same, and (b) their ultimate self-interest is better served by such choices. A second interpretation derives from the general notion that personality differences tend to be more pronounced as the situational norms and demands are weaker (*cf.* Snyder & Ickes, 1985). Indeed, it may well be that the differences underlying pro-social and pro-self individuals are overshadowed by powerful social norms dictating the appropriateness and moral correctness of commuting by public transportation. It goes without saying that such norms are more prominent when cars are believed to be very polluting as opposed to mildly polluting. The overall finding that preferences for public transportation were much greater when individuals believed that car use had a large (rather than a small) impact on the environment is consistent with the previous hypothesis. Moreover, this finding complements prior research on social dilemmas by indicating that individuals exhibit greater cooperation as the basis for collective rationality (i.e. concern for collective outcomes) becomes more salient (for a recent review, see Van Lange *et al.*, 1992), and by supporting the notion that individual commuters do not only consider the immediate individual outcomes of their choices (i.e. travel time), but also consider the long-term collective consequences. Setting theoretical issues aside, this finding may be relevant for educational purposes because there appears to be a growing consensus among environmental experts that excessive car use is among the main causes of environmental pollution, and that technological

improvements of cars (such as more advanced car catalysts) may not be sufficient to reduce these problems significantly (*cf.* Stern, 1992).

A third finding concerns the idea that when two barriers to use public transportation are simultaneously removed, their combined effect is more pronounced than the sum of their separate effects. This notion, which formed the basis for hypothesis 5, received a fair amount of support. That is, we found some support for the hypothesis that preferences for public transportation are a multiplicative function of average travel time and variability in travel time — these benefits can be construed as two conditions that must be met for a substantial increase in public transportation preferences to occur. However, our findings seemed to indicate that this multiplicative effect was obtained for any combination of obstacles being eliminated (i.e. any pair of anti-car or pro-public transportation judgements: favourable travel time, smaller or at least equal variability, and much greater impact of cars on level of pollution). This indicates, first, that commuters may apply a compensatory decision rule in thinking about commuting by car versus public transportation considering individual and collective outcomes to be commensurable — that is, individuals translate even two disparate attributes onto a common scale of utility (*cf.* Abelson & Levi, 1985). Second, in addition to simply applying the addition-of-utilities rule, individuals may also apply a non-additive, multiplicative rule in forming preferences. As outlined earlier, it seems likely that commuters use a multiplicative rule because presumably a combination of obstacles have to be removed before public transportation can really compete with the multiple benefits associated with cars.

One more specific finding deserves brief attention. The current work provides good support for the claim that the decision situation indeed represents a social dilemma. Concerns reflecting self-benefit (e.g. travel flexibility and protection against weather) were associated with stronger preferences for commuting by car, whereas concerns reflecting collective benefit (i.e. environmental pollution) were associated with stronger preferences for commuting by public transportation (of course, our experimental instructions may have somewhat influenced the latter relationship). Moreover, the finding that commuters who assigned greater value to the environment exhibited stronger preferences for public transportation (i.e. pro-socials) adds further credence to this claim. In this regard, it should also be noted that interdependence theory (Kelley & Thibaut, 1978) has provided a useful framework for studying decisions in this real-life social dilemma by assuming that interdependent behaviour is not only shaped by purely self-interested concerns — a claim often made by traditional theories of social dilemmas (e.g. game and rational choice theory) — but also by the broader implications of behaviour, such as concern for the collective well-being.

Before closing, we wish to outline some limitations of the current work. First, an unintended limitation of the present study is that the sample of commuters consisted predominantly of people with pro-social orientations (approximately 80 per cent), which may be due to a process of self-selection — 36 per cent of the original sample did not return their questionnaires. Indeed, previous research has demonstrated that, relative to pro-socials, pro-self individuals are less willing to participate as subjects in experiments (McClintock & Allison, 1989). Consequently, the current findings regarding the overall preference for public transportation, and the main effect for pollution may have been positively biased. In contrast, the effects for travel time and variability (i.e. two self-interested concerns) may have been somewhat underestimated.

From a somewhat different perspective, the possibility of such selection-biases may also have a practical implication because it suggests that programmes aimed at altering people's environmental behaviours may attract a group of primary pro-social individuals rather than individuals with pro-self orientations.

The other limitations are related to the scenario paradigm that was used in the present study. This methodology measures commuters' reports of how they would behave in a situation given certain travel time and environmental conditions. Consequently, one potential confinement of this methodology is that it does not rule out response tendencies such as self-presentation or social desirability, which may account for the overall strong public transportation preference that was found among a sample of daily and regular car commuters. However, such tendencies are less likely to account for the effects involving travel time and variability, because these are primarily self-interested concerns. Moreover, the measurement of social value orientation appears to be free of social desirability tendencies (e.g. Platow, 1992). In this regard, it should also be noted that several features of the current study (e.g. using actual commuters, realistic outcomes) to some extent contributed to the ecological validity of the current findings. Moreover, other measures included in this work (i.e. ratings of travel attributes) suggest that the commuting situation was indeed perceived as a social dilemma. A third but related limitation is that the factors promoting use of public transportation in the present study may in reality be overshadowed by powerful social and situational constraints (e.g. car as status symbol, low accessibility of public transportation). Thus, it would be fruitful to replicate the current work with a more direct focus on behaviour.

Nevertheless, we believe that the scenario paradigm is a constructive, albeit preliminary, research strategy for developing causal models of human decision making in real-life social dilemmas. That is, the current findings may help researchers to further design and implement more costly and time-consuming field studies in the context of one of the most pervasive dilemmas society is facing today, environmental pollution.

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APPENDIX

Description of commuting situation (original in Dutch)

Imagine that, within 10 years from now, you find yourself in the following commuting situation. You are living in a suburb of a middle-sized city in the Netherlands. The company you are working for is located 40 kilometres from your house. This distance can be covered by taking your car or public transportation. There is a train station within a three-minute walk of your house. From there, the train takes you to a station located within a two-minute walk of the company. Alternatively, near your home is the onramp to the highway that leads directly to your work. Every working day you commute to work, and every day you have to make a decision whether to commute by car or public transportation. All other employees of the company face the same decision situation, and use the same route either by car or train. They also have to decide between commuting by car or public

transportation. Your decision, as well as those of other commuters, have consequences for both your travel time and the level of environmental pollution.

Pollution (large impact-condition)

Within 10 years from now the environment will be in a very bad condition. At that time, scientists have determined that the hole in the ozone layer has grown, and that the earth temperature has risen due to the greenhouse effect. Moreover, in many places around the world there is serious smog pollution and acid rain, which contribute to the extinction of the forests, and may possibly form a threat to public health. Private car use is one of the main polluters of the environment. Despite the introduction of catalytic converters for the car and other environment preserving measures our environment is still severely affected by cars. In contrast, public transportation has *hardly* any impact on the level of environmental pollution.

Travel time (PTT longer-condition)

The average travel times associated with commuting by car or public transportation differ. It always takes you longer to commute by public transportation than by car. On average, the travel time by public transportation will be 60 minutes (including a three- and two-minute walk), whereas by car it will be 40 minutes.

Variability (PTV smaller-condition)

Public transportation has quite a stable travel time. When commuting by public transportation your travel time will vary between 58 and 62 minutes. In contrast, the travel time by car is quite unstable, varying between 24 and 56 minutes. That means that on one day it may take you 40 minutes to go to work, another day perhaps 24 minutes, whereas another day it may take 56 minutes. The precise travel times by car or public transportation are dependent on a great variety of factors. In practice, it is very hard to predict exactly how long it will take to get to work. Nevertheless, it has been consistently found that the variability in travel time commuting by public transportation is much smaller than by car.

To summarize:

(a) In contrast to public transportation, cars severely pollute the environnment.
(b) The travel time by public transportation is longer (60 minutes) than by car (40 minutes).
(c) The variability in travel time by public transportation is much smaller (58–62 minutes) than by car (24–56 minutes).

It is a weekday morning. At about 8:30 a.m. you want to arrive at work. Please decide whether you want to commute by car or public transportation.