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Day Traders and the Disposition Effect

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The disposition effect refers to the tendency to hold losing investments and sell profitable ones. We examine day trader transactions for evidence of a disposition effect. We find that approximately 65% of sample traders hold losing trades longer than profitable ones, providing evidence that sample day traders display the disposition effect.

Expected utility theory is the reigning paradigm for decision making under uncertainty. People are believed to behave according to the von Neumann and Morgenstern [1944] axioms of rational choice. Experimental evidence suggesting otherwise, however, is what led Kahneman and Tversky [1979] (KT) to develop prospect theory.

One implication of prospect theory is that individuals will take gambles inconsistent with expected utility maximization. Shefrin and Statman [1985] extend prospect theory to investor behavior, hypothesizing that investors may hold losing trades longer than profitable ones, a phenomenon they call the disposition effect.[1] The implications are profound. Empirical evidence for the disposition effect suggests prospect theory is a better model than expected utility theory.

Shefrin and Statman [1985] tested the disposition effect by examining trading data over the period 1964–1970. They observed that losses represent approximately 40% of all transactions regardless of time held. They assert that this supports the disposition effect because it is inconsistent with Constantinides' [1984] normative theory of tax-motivated trading. Shefrin and Statman [1985] also analyzed mutual fund transactions from 1961 through 1978. Tax considerations should cause a high (low) redemption/purchase ratio following a market decline (advance). They found no statistically significant relationship.

Odean [1998] examines discount brokerage house accounts from 1987 through 1993 by analyzing the proportion of gains realized (PGR) and the proportion of losses realized (PLR). He found the sample PGR to be 14.8% and the sample PLR to be 9.8%, a highly significant difference that also supports the disposition effect.

Grinblatt and Keloharju [2001] test for the disposition effect in Finnish Central Securities Depository trades. Stock sales were 32% less likely following a large loss. The statistic for moderate price movements was 12%. They argue this is due to the disposition effect. Heisler [1994] finds evidence of loss aversion in the Treasury bond futures market.

Barber and Odean [1999] explore alternative hypotheses, including anticipation of tax law changes, portfolio rebalancing, and belief in mean reversion. They conclude that the disposition effect is the most plausible explanation for investors' tendency to hold losers and sell winners.[2]

Our research examines a large sample of day traders, a group not previously examined in the academic literature. Day traders are interesting for two reasons. First, most alternative hypotheses do not apply to them because they tend to have short holding periods. Therefore, day traders provide a powerful test of the disposition effect.

Second, day trading references advise day traders to cut losses and hold profits. For example, Lukeman [2000, p. 4] writes, "Traders end up cutting their profits short and letting their losses run—the opposite of what they should be doing in order to be successful." Farrell [1999, p. 49] states, "What is a day trader's recipe for disaster? Cutting your winning trades and riding your losses right into the ground." Yet an investigation by the North American Securities Administrations Association (NASAA [1999]) concluded that 70% of day traders will almost certainly lose everything they invest. These observations lead us to conjecture that day traders may exhibit the disposition effect.

Our results do reveal evidence of the disposition effect among day trader transactions. Portfolio rebalancing, tax law changes, and transaction cost avoidance on low-priced stocks are irrelevant to day traders. This leaves only a belief in mean reversion (or a belief that losers will outperform winners in the future) as a possible alternative for why they may hold unprofitable trades longer than profitable ones.

We test for this alternative by regressing trade profitability versus holding time. An inverse relationship suggests that holding losing trades is not consistently profitable. We find a statistically significant inverse relationship between time held and profitability, and conclude that the disposition effect is a better explanation of day trader behavior than a belief in mean reversion.

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We briefly describe some technical points about prospect theory in the next section. We then describe our sample and the methodologies used. Finally, we report results and offer conclusions.

Prospect Theory, Value Functions, and Reference Shifts

KT [1979] assert that individuals respond to changes in physical stimuli rather than to intensity level. This extends to non-sensory attributes like wealth. KT hypothesize that individuals maximize a *value* function on wealth changes, rather than a *utility* function on wealth level.

The KT value function is defined over deviations from a reference point. Prospect theory does not specify the reference point, but KT suggest it will be a convenient one, e.g., an asset's purchase price. KT hypothesize that the value function is concave above the reference point and convex below, implying that the marginal value of gains and losses decreases with increasing magnitude. A discontinuity at the reference point comes from the observation that the value loss from a given dollar loss is often greater than the value gain from an equivalent dollar profit (see Figure 1).

Prospect theory also allows for "reference shifts" that may occur when gains and losses are measured mentally against expectations. Discrepancies between the current position and the reference point can occur because the individual may not have adapted to recent wealth changes. As KT [1979] state, "The present theory implies that a negative translation of a choice problem, such as arises from incomplete adaptation to recent losses, increases risk seeking in some situations" (p. 287). Traders may exhibit risk-seeking due to a recent loss. Thaler and Johnson [1990] discuss implications, proposing a quasi-hedonic editing rule, and Weber and Camerer [1998] demonstrate how the value function and reference shifts combine to explain the disposition effect.

Data and Methodology

Data Description

We examine data from seven branch offices of a national securities firm specializing in day trading. Data are available from February 1998 until October 1999. However, as Table 1 shows, the data from every branch do not cover this entire period. The data set consists of all information the firm receives when a client places an order. Not every order constitutes a trade because the firm's recording system includes data such as "order send," "order pending," "cancel send," "cancelled," and "reject order," in addition to "confirmed." We use only confirmed trades for analysis. Table 2 presents an excerpt from the data.

Many trades result in a "split fill." For example, a 1,000-share buy order may not be filled in a single transaction. The trader may buy, say, 500 shares, another 100 shares a few seconds later, and the final 400 some time after that. Each transaction is a distinct confirmed trade, even though the original order was for 1,000 shares. Fortunately, the order number remains the same no matter how many transactions are required to complete the order. For example, order 513 (Table 2) is for 300 shares of HD. Three separate fills were made, with the first fill occurring at 12:14:58 p.m. and the final one at 12:15:18 p.m.

Methodology

We use what we call a trade-matching methodology for translating confirmed orders into completed trades. The methodology matches buy and sell trades (also short-sell and buy trades) for a particular stock on a daily basis. Consequently, trades not closed on the initiation day are excluded from the analysis.

The trade-matching technique begins by grouping the confirmed trades from a particular branch, trader, and trading day by order number. Buy and sell trades for a particular stock are then paired by number of shares traded. For example, if order number 100 is a buy order for 1,000 shares of IBM, it is paired with

FIGURE 1
Prospect Theory Value Function

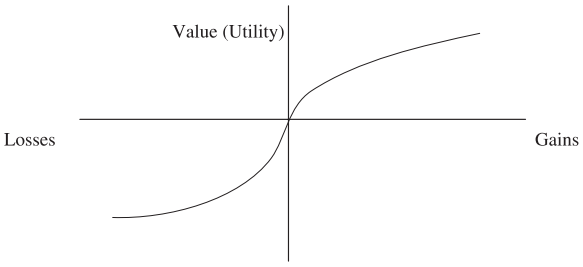

Table 1. *Calendar Months with Available Trading Data*

Branch	Calendar Months
A	February 1998–October 1999
B	October 1998–October 1999
C	September 1998–October 1999
D	September 1998–October 1999
E	August 1998–May 1999
F	January 1999–June 1999
G	July 1998–October 1999

Note: Data from each branch do not start with the same month because new branches commenced trading at different times. Data from most of the branches end in October 1999 because the data were acquired in early November 1999.

the next sell order for 1,000 shares of IBM. Short-sale transactions are handled in a similar way.[3] A sample of trade-matching output is shown in Table 3. We analyze holding times to make inferences about the disposition effect.

The trade-matching technique yields 100,032 trades, and we use gross profit to distinguish between profitable and losing trades.[4] There are 51,881 profitable trades, 41,183 losing trades, and 6,968 break-even trades. There are 361 traders with profitable trades, and 359 with losing trades. It is possible for a trader to have only profitable (or losing) trades. We compare the average time a given trader's profitable trades are held to the average time all the trader's losing trades are held. We exclude data for traders with less than three profitable (losing) trades because we believe that time held for one or two trades does not provide enough data to compute a reliable average. This filter eliminates twenty-one traders from the profitable trader subset and twenty-five from the losing trader subset. The final data set contains 324 traders.

Trade-Matching Methodology Results

Trader-Level Results

Table 4 gives an excerpt of the trade-matching methodology results. Column 9 of Table 4 shows the difference between the average time the trader holds profitable trades and the average time she holds losing trades. If the trader exhibits the disposition effect, the figure in column 9 will be negative. Assuming that most day traders lose money (in accordance with NASAA [1999]), we hypothesize that more traders will have a negative figure in column 9 than a positive figure. We find that 123 traders (38.0%) hold profitable

Table 2. *Examples of Confirmed Trade Data*

Trade Date	Order No. Assigned By the Firm	Order Status	Trader Name	Stock Name	Order Type Buy/Sell	Number of Shares	Price	Time
1/4/99	509	Confirmed	Y	SPLN	Buy	500	17.75	1:11:34
1/4/99	489	Confirmed	X	DBCC	Short-Sell	300	19	1:12:01
1/4/99	512	Confirmed	Y	XLNX	Buy	1000	66	1:12:58
1/4/99	511	Confirmed	Z	SPYG	Buy	412	15.9375	1:13:04
1/4/99	515	Confirmed	Y	GMGC	Buy	1000	5.96875	1:14:49
1/4/99	513	Confirmed	Z	HD	Buy	100	59.125	12:14:58
1/4/99	513	Confirmed	Z	HD	Buy	100	59.125	12:15:04
1/4/99	513	Confirmed	Z	HD	Buy	100	59.125	12:15:18
1/4/99	518	Confirmed	Z	LRCX	Short-Sell	500	18.9375	1:18:10
1/4/99	519	Confirmed	Y	XLNX	Sell	1000	65.90625	1:18:18
1/4/99	520	Confirmed	Y	XLNX	Short-Sell	1000	65.875	1:18:58
1/4/99	521	Confirmed	Z	OXHP	Sell	100	16.125	1:19:00
1/4/99	521	Confirmed	Z	OXHP	Sell	400	16.125	1:19:00
1/4/99	522	Confirmed	W	LCOS	Short-Sell	500	55.25	1:19:38
1/4/99	525	Confirmed	Y	GMGC	Sell	300	6.046875	1:22:31
1/4/99	527	Confirmed	Y	BVSN	Sell	300	34.3125	1:22:33
1/4/99	525	Confirmed	Y	GMGC	Sell	700	6.046875	1:23:21

Note: Examples of confirmed trades extracted from the available day trading data. Order number is assigned sequentially by the firm because traders place orders throughout the trading day.

Table 3. *Final Results of Trade-Matching Methodology Procedure*

Date	Trader	Buy Order No.	Sell Order No.	Time Held	Gross Profit	Net Profit
1/13/99	X	1072	1130	10	–93.75	–123.75
1/13/99	X	1034	1130	19	–125	–155
1/13/99	X	937	998	23	–156.25	–186.25
1/13/99	X	850	868	7	–15.625	–45.625
1/13/99	X	752	827	27	0	–30
1/13/99	X	448	493	13	93.75	63.75
1/13/99	X	333	353	7	281.25	251.25
1/13/99	X	108	367	93	46.875	16.875

Note: Trade-matching methodology results for a few trades for a single day trader. Trade-matching methodology begins with grouping buy and sell trades by order number, then pairing buy and sell orders by stock with all other trades of the same amount during that trading day. These pairings allow the gross profit and the time trade is held to be calculated for each individual trade. Commissions are assumed to be $30 per round-trip transaction, so net profit is simply gross profit minus $30.

Table 4. *Sample of Trade-Matching Methodology Disposition Effect Analysis Results*

Trader	No. of Months Traded	Profitable Trades			Unprofitable Trades			Diff. in Time Held, Cols. 4–7	t-statistic	
		Total No.	Average Time Held[a]	Variance of Time Held	Total No.	Average Time Held[a]	Variance of Time Held		Individual Trader	Within-Population
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7	Col. 8	Col. 9	Col. 10	Col. 11
A	7	47	54.75	5,271.70	63	15.62	2,053.97	39.12	3.25	17.54
B	14	273	19.63	2,206.43	104	71.63	8,234.83	–52.00	–5.57	–23.31
C	2	6	46.63	776.31	4	89.00	14,762.50	–42.38	–0.69	–19.00
D	2	50	22.93	685.79	35	37.92	4,550.32	–14.99	–1.25	–6.72
E	2	98	31.97	2,384.15	30	57.55	5,895.44	–25.58	–1.72	–11.47
F	4	52	21.06	4,178.54	40	22.94	3,008.17	–1.88	–0.15	–0.84
G	4	199	29.06	1,865.45	92	64.83	5,317.57	–35.77	–4.36	–16.04
H	2	5	108.13	7,622.92	4	26.50	5,296.00	81.63	1.53	36.60
I	2	39	36.51	2,562.89	49	82.65	2,077.48	–46.14	–4.44	–20.69
J	10	1008	23.23	2,415.95	317	36.77	5,226.05	–13.53	–3.11	–6.07
K	2	59	9.82	179.54	41	9.13	267.87	0.69	0.22	0.31
L	2	156	23.52	1,920.41	53	82.66	12,230.36	–59.15	–3.79	–26.52
M	2	5	3.92	11.06	4	14.00	13.00	–10.08	–4.31	–4.52
N	1	8	36.00	3,413.71	17	39.82	5,149.03	–3.82	–0.14	–1.71
O	2	81	14.84	864.61	67	25.38	1,142.30	–10.54	–2.00	–4.73
P	3	42	70.69	5,731.20	26	73.98	4,268.07	–3.29	–0.19	–1.47
Q	11	418	35.72	1,694.87	316	51.80	5,027.66	–16.08	–3.60	–7.21
R	6	233	41.91	3,597.66	154	70.83	7,432.24	–28.91	–3.62	–12.96
S	3	11	64.06	6,709.35	5	109.89	156.33	–45.83	–1.81	–20.55
T	2	30	10.31	119.53	44	15.85	652.83	–5.54	–1.28	–2.49
U	7	90	9.39	132.47	82	5.83	11.98	3.57	2.80	1.60
V	5	29	59.47	3,453.69	13	44.93	530.75	14.54	1.15	6.52
W	2	39	18.00	1,251.04	36	34.96	2,653.78	–16.96	–1.65	–7.60
X	2	28	76.24	2,875.75	31	25.05	177.67	51.18	4.92	22.95

Note: Column 9 shows the difference between how long profitable trades are held compared to how long losing trades are held. A negative sum in column 9 means the trader holds losing trades longer than profitable trades on average (i.e., displays the disposition effect). The individual trader t-statistic measures the statistical significance of the column 9 figure for each trader individually. The within-population t-statistic measures the statistical significance of the column 9 figure compared to the average of the other traders in the sample.

[a]Given in minutes.

trades longer than losers, while 201 traders (62.0%) hold losing trades longer than winners.

We estimate two sets of by-trader t-statistics. The first set (column 10) tests the time differences between profitable and losing trades by trader using the procedure of Dixon and Massey [1969, p. 119]:

$$t = \frac{(Average\ Profitable\ Time - Average\ Losing\ Time)}{\sqrt{[(S^2/n)_{profitable} + (S^2/n)_{losing}]}} \quad (1)$$

where S^2 is variance. We hypothesize that the disposition effect will cause more traders to have a statistically significant negative time difference than a statistically significant positive time difference. Our results show that sixty-seven traders (20.7%) have a significantly negative time difference (5% level, two-tailed test), and twenty-nine traders (8.9%) have a significantly positive time difference. The results show that more than twice as many traders hold losing trades significantly longer than winning trades.

To further examine the disposition effect, we compare each trader's time held difference with the average time held difference for the entire group. The second set of t-statistics (Table 4, column 11) compares the difference in time held for each trader with the rest of the sample. We hypothesize that the disposition effect will cause more traders to exhibit a statistically significant negative time difference.

We find that 149 traders (46.0%) have a significantly negative within-population t-statistic (5% level, two-tailed test). Eighty-one (25.0%) have a significantly positive within-population t-statistic (5% level, two-tailed test). More than twice as many traders hold losing trades longer than winning trades.

Our primary hypothesis is that traders will hold losers longer than winners, but small differences may not provide strong enough support for the disposition effect. Therefore, we perform sign tests to examine whether the number of traders holding losing trades longer exceeds the number holding profitable trades longer *by a statistically significant margin*.

We estimate three test statistics, one based on the raw frequency, the second based on the frequency of statistically significant t-statistics shown in column 10 of Table 4, and the third based on the frequency of statistically significant t-statistics shown in column 11 of Table 4. We use the normal approximation formula of Siegel and Castellan [1988, p. 84]:

$$Z = \frac{2X - 1 - N}{\sqrt{N}} \quad (2)$$

where X is the number of traders in the majority group, and N is the number of traders.

Sign test results are reported in Table 5. The results suggest that, at the 1% level, the majority of sample traders hold losing trades longer than profitable trades. We interpret this as support for the disposition effect.

Aggregate Results

Our hypothesis is that the disposition effect will cause the average trader to hold unprofitable trades longer than profitable ones. For all traders, the average of average holding times for profitable trades was 27.05 minutes (variance = 480.38), and 32.14 minutes (variance = 773.01) for losing trades. Sample traders held losing trades approximately five minutes longer than profitable ones.[5] The within-population t-statistic for the difference between the overall average of time held for profitable trades and for losing trades is –2.58, indicating that sample traders hold losing trades longer than profitable ones [see Equation (1)]. We interpret this as evidence of a disposition effect among sample traders.

We also compare the 51,881 individual profitable trades to the 41,183 individual losing trades to see if the average unprofitable trade is held longer than the average profitable trade. The average holding time for all profitable trades is 23.12 minutes (variance = 2,143.91), while the average for all losing trades is 26.75 minutes (variance = 2,909.58). The t-statistic for the difference of means is –10.83, a highly significant result that supports the existence of the disposition effect.

In order to distinguish between the disposition effect and a belief in mean reversion, gross profit is regressed against time held for the 100,032 trades in the trade-matching methodology data set. A White test shows evidence of heteroscedasticity in the data, so the following coefficients come from a weighted least squares regression.

Table 5. *Trade-Matching Methodology Sign Test Results*

Criteria	No. Holding Losing Trades Longer	No. Holding Profitable Trades Longer	N	Z
# of Traders	201	123	324	4.28*
t-statistic[1]	67	29	96	3.78*
t-statistic[2]	149	81	230	4.42*

Note: These tests compare the number of traders who display the disposition effect with the number of traders who do not for three different categories. The number of traders refers to the number with negative versus positive numbers in column 9 of Table 6. The two t-statistics compare the number of traders with t-statistics that are significant at the 5% level from columns 10 and 11 in Table 6.

[1]t-statistic comparing each trader's profitable versus losing time held.

[2]t-statistic comparing each trader with the group.

*Significant at the 1% level.

$$\begin{array}{lll} Trade = 32.03 - 0.2769\ (Trade\ Holding\ Time) & & \\ Gross \quad t = 30.28 & t = -6.08 & \\ \Pr ofit \quad p = 0.0001 & p = .0001 & R\text{-}squared = 0.0004 \end{array} \quad (3)$$

The results show a statistically significant inverse relationship between trade holding time and trade profitability. Assuming day traders are seeking profit, we interpret this result as supporting the disposition effect hypothesis over a belief in mean reversion.

Short-Sale Transactions

We examine short-sale trades separately to explore the robustness of our results. Our hypothesis in all the following tests is that the disposition effect will cause losing trades to be held longer than winning trades. We estimate the same test statistics on the 19,839 short-sale transactions previously performed on the entire sample. 199 traders had at least three profitable and three losing short-sale transactions. Of these, 102 traders (51.3%) held losing trades longer on average than profitable trades, while 97 (48.7%) held profitable trades longer on average. Fifteen (7.5%) held losing transactions significantly longer than winners (5% level, two-tailed test), while twenty-one (10.5%) held profitable transactions significantly longer.

Within-population t-statistics show that sixty-five traders (32.6%) exhibited significantly longer times on losing transactions, while forty-five (22.6%) exhibited significantly longer times on profitable transactions. Sign tests on the difference between the number of traders holding losing trades longer and the number holding profitable trades longer yield no significant differences at conventional levels. Table 6 shows those results.

The average of average times held for profitable trades for the 199 traders is 25.26 minutes (variance = 798.74), and 26.73 minutes (variance = 678.79) for losing short-sale trades. The within-population t-statistic for the difference between the overall average of times held for profitable and losing trades is a statistically insignificant –0.54.

Table 6. *Trade-Matching Methodology, Short-Sell Trades Only, Sign Test Results*

Criteria	No. Holding Losing Trades Longer	No. Holding Profitable Trades Longer	N	Z
# of Trades	102	92	199	0.40
t-statistic[1]	15	21	36	0.83
t-statistic[2]	65	45	110	1.81

Note: These tests compare the number of individual short-sell traders who display the disposition effect with the number who do not for three different categories. The number of trades refers to the number with negative versus positive numbers in column 9 of Table 6. The two t-statistics compare the number of traders with t-statistics that are significant at the 5% level from columns 10 and 11 in Table 6.
[1]t-statistic comparing each trader's profitable versus losing time held.
[2]t-statistic comparing each trader with the group.
*Significant at the 1% level.

When we compare the 9,831 individual profitable short-sale trades to the 8,521 losing trades,[6] we find the average holding time for profitable short-sale trades is 23.44 minutes (variance = 1,957.74). The average holding time for losing trades is 21.42 minutes (variance = 2,034.35). The t-statistic for the difference in average holding times is a statistically significant +3.06, inconsistent with the disposition effect.

The short-sale subsample shows no statistically significant evidence of the disposition effect. Profitable short-sale transactions were actually held an average of 2.02 minutes longer than losers. Thus, we find no support for the disposition effect here, and we note that traders appear to treat short-sale transactions differently than long transactions.

Short and long transactions may exhibit differing characteristics for several reasons. Traders may be reluctant to hold losing positions when short-selling because losses on short-sale transactions are unbounded. Survival bias may also provide an explanation: Traders who retained losing trades may have been forced out of the sample, leaving only those who had learned to cut losses.

This explanation has particular credibility given the bull market during the sample period. The Nasdaq composite index rose an impressive 83% from February 1998 through October 1999. Regardless of the motive, however, investors appear to prefer long positions, evidenced by the fact that only about 20% of sample transactions are short sales.

But the short-sale results raise the issue of whether traders who engage in short sales are different from those who do not. We partition the data between trades by traders who short-sell versus those who do not, and examine each subset separately. A total of 286 traders completed at least one short sale. Trades from short-sellers make up 96.4% of the total (96,469 trades), of which 76,630 trades are long and 19,839 are short. Eighty-one sample traders made no short sales. Their transactions make up 3.6% of the total (3,543 transactions). We consider four subsamples: 1) all short-sale trades (analyzed in the previous section), 2) all trades made by traders that short-sell, 3) long trades made by short-selling traders, and 4) trades made by traders that do not short-sell. Sign test results for the first subsample are presented in Table 6, while sign test results for the other three are presented in Tables 7, 8 and 9.

The results in Table 7 show that significantly more short-selling traders hold losing trades longer than profitable ones, supporting the disposition effect at the 1% level. Likewise, long trades from short-selling trad-

ers (see Table 8) provide significant evidence for the disposition effect. Table 9 presents results from traders that engage only in long trades. We find that this group appears to hold profitable and losing trades for about the same amount of time.

Holding Time Mean Difference Test Results

Table 10 shows mean difference test results on day trader holding times for the four short-sale subsamples, along with full sample trade-matching results. Group results are calculated from the average of by-trader average holding times. Individual results are calculated from trade data without regard to trader (in other words, group results are trader-weighted, individual results are unweighted).

We observe from Table 10 that short-selling traders overall appear to hold losing transactions significantly longer than profitable ones (see Table 10, rows 1 and 2). Likewise, short-selling traders hold losing long transactions significantly longer than profitable long transactions (Table 10, rows 3 and 4). By-trader data for the subsample of traders that do not short-sell reveal no significant difference in holding times between losing and profitable trades (Table 10, row 5). In contrast, unweighted data for this subsample suggests that they hold losers significantly longer (Table 10, row 6).

We conclude from our short-selling subsamples that failure to display a disposition effect relates to the transaction itself, rather than to trader characteristics. When considering only long transactions, short-selling traders appear to behave in the same way as non-short-selling traders.

We find significant support for the disposition effect in the test statistics summarized in Table 10, with supporting evidence in seven of the ten categories. Statistically significant evidence refuting the disposition effect appears in only a single test statistic within a category of trades, the individual statistic within the short-sale subsample.

Table 7. *Trade-Matching Methodology, All Trades by Short-Sellers, Sign Test Results*

Criteria	No. Holding Losing Trades Longer	No. Holding Profitable Trades Longer	N	Z
# of Traders	179	96	275	4.94*
t-statistic[1]	60	24	84	3.82*
t-statistic[2]	130	60	190	5.01*

Note: These tests compare the number of traders from this group who display the disposition effect with the number who do not for three different categories. The number of traders refers to those with negative versus positive numbers in column 9 of Table 6. The two t-statistics compare the number of traders with t-statistics that are significant at the 5% level from columns 10 and 11 in Table 6.
[1]t-statistic comparing each trader's profitable versus losing time held.
[2]t-statistic comparing each trader with the group.
*Significant at the 1% level.

Table 8. *Trade-Matching Methodology, Only Buy Trades for Traders With Short-Sell Trades, Sign Test Results*

Criteria	No. Holding Losing Trades Longer	No. Holding Profitable Trades Longer	N	Z
# of Traders	178	93	271	5.10*
t-statistic[1]	55	21	76	3.79*
t-statistic[2]	128	58	186	5.06*

Note: These tests compare the number of traders from this group who display the disposition effect with those who do not for three different categories. The number of traders refers to those with negative versus positive numbers in column 9 of Table 6. The two t-statistics compare the number of traders with t-statistics that are significant at the 5% level from columns 10 and 11 in Table 6.
[1]t-statistic comparing each trader's profitable versus losing time held.
[2]t-statistic comparing each trader with the group.
*Significant at the 1% level.

Conclusion

The disposition effect is the tendency of investors to retain losing positions while selling profitable ones quickly. This tendency contradicts expected utility maximization and conventional wisdom. Our results support the hypothesis that sample day traders exhibit the disposition effect.

On average, 62% of sample traders hold losing trades longer than profitable ones, while 38% hold profitable trades longer. Nearly twice as many traders hold losing trades longer than profitable ones. Sign test results suggest that the difference in frequency is significant at the 1% level.

T-statistics for individual traders (profitable trades versus losing trades) show that nearly 26%

Table 9. *Trade-Matching Methodology, Traders With Only Buy Trades, Sign Test Results*

Criteria	No. Holding Losing Trades Longer	No. Holding Profitable Trades Longer	N	Z
# of Traders	22	27	49	0.57
t-statistic[1]	7	6	13	0.00
t-statistic[2]	9	17	26	1.37

Note: These tests compare the number of traders from this group who display the disposition effect with those who do not for three different categories. The number of traders refers to those with negative versus positive numbers in column 9 of Table 6. The two t-statistics compare the number of traders with t-statistics that are significant at the 5% level from columns 10 and 11 in Table 6.
[1]t-statistic comparing each trader's profitable versus losing time held.
[2]t-statistic comparing each trader with the group.

Table 10. *Summary of Differences in Time Held t-Statistics*

	Profitable Trades		Losing Trades		
	Average of Time Held[a]	Variance of Time Held	Average of Time Held[a]	Variance of Time Held	t-statistic
Short-Sale Traders, All Trades					
Group	26.13	431.82	32.25	770.00	–2.93*
Individual	22.56	2064.72	26.25	2818.29	–11.01*
Short-Sale Traders, Only Buy Trades					
Group	24.98	401.57	31.77	766.84	–3.27*
Individual	22.34	2090.91	27.57	3023.03	–13.54*
Traders With Only Buy Trades					
Group	33.60	731.49	31.84	792.56	0.30
Individual	36.05	3796.18	42.6	5587.33	–2.65*
Short-Sale Trades Only					
Group	25.26	798.74	26.73	678.79	–0.54
Individual	23.44	1957.73	21.42	2034.35	3.06*
TMM,[1] Whole Data Set					
Group	27.05	480.38	32.14	773.01	–2.58*
Individual	23.12	2143.91	26.75	2909.58	–10.83*

Note: Group results refer to the average of the average time held after trades are grouped for each trader. Individual results refer to statistics compiled for individual trades without regard to the trader who is making the transaction. The t-statistic refers to the difference in the average time profitable trades are held compared to the average time losing trades are held.
*Significant at the 1% level.
[1]Trade-matching methodology.
[a]Given in minutes.

of sample traders hold losers longer than winners at the 5% level. Just over 10% hold profitable trades significantly longer at the 5% level. Comparing individual traders to their peer group also provides evidence supporting the disposition effect, as does examination of the unweighted trades. Results appear robust with respect to classification into profitable and losing trades (i.e., gross versus net profits as reference points).

There are several possible alternative hypotheses for investor behavior with respect to gains and losses, such as portfolio rebalancing and tax law changes, but we find they do not apply to day traders. Furthermore, regressions of gross profit versus time trades are inconsistent with a belief in mean reversion. We conclude that the sample evidence is consistent with the hypothesis that day traders display the disposition effect.

Notes

1. To our knowledge, Shefrin and Statman [1985] were the first to use this terminology.
2. Other studies include Starr-McClure [1995], Poterba [1987], Weber and Camerer [1998], and Ferris, Haugen, and Makhija [1988].
3. Split offsets are not included in the trade-matching transactions. We excluded these trades for computational ease.
4. We use gross profit rather than net profit to separate trades. We assume that traders use entry price as the mental benchmark. The validity of this assumption is confirmed by the fact that 6,968 (nearly 7%) of trades have gross profit exactly equal to zero. Moreover, we performed all the statistical tests reported in this section again, using net profit equal to gross profit minus $30 round-trip commissions and $5 opportunity cost, and using some simple assumptions about average trade size and the riskless interest rate. Our results were essentially the same.
5. These statistics are trader-weighted averages, not the average across all individual trades. 61,304 trades (7.5%) have gross profit equal to zero.

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